

solplan review

the independent journal of energy conservation, building science & construction practice

Contents . . .

Reading an MSDS	3
Window Innovations '95	4
Premature Obituary? EnviroSafe Cabinets is still open	5
Measuring airflows: the Garbage Bag Test	6
Locating the Neutral Pressure Plane	7
Masonry Fireplaces	8
Multi-unit design evaluation guidelines	9
HOT-2000 Update (v7.1)	9
Letter to the Editor	9

Technical Research Committee News	10
Manufactured Wood Floor Systems Testing Program, Engineered wood product installation practices, TRC Bulletin Board, Envirohome, Sprinklers	
Combustion Vent Clearance	11
Doors as Sound Barriers	12
What is STC (Sound Transmission Class)?	12
The Healthy Household (book review)	13
E-House Indoor Air Quality Product Guide™	13
The Great Canadian Reno-Demo Project	14
Fireplace Doors and Smoke Spillage	15
GreyWater Heat Recovery	18
Coming Events	19

Understanding MSDS



From the editor . . .

There has been a loss of faith in public and social institutions in recent years. There seems to be a growing belief that no public agency can possibly do any good. We are constantly hearing the chant: "deregulation is good; we must be competitive in the global marketplace; we can't afford to . . .".

Underlying this refrain is a very self centred belief that the unfettered free market is the best social organization known to mankind. This is leading to the wholesale dismantling of many social structures that have been key in developing and defining our society as it exists today, whether or not there is any justification for the elimination of the programs or regulations.

In the USA the new ideology is pushing to get rid of the Environmental Protection Agency. The new Ontario government, following in the footsteps of Alberta, is dismantling various programs and initiatives. The federal government has a bill in the works that would in effect eliminate any form of environmental and consumer scrutiny or regulation in a whole area of business activity. Much of this activity seems to be pushed without regard for the consequences.

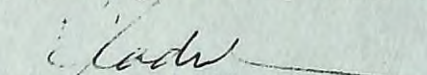
What seems to have been forgotten is that many of these regulations were implemented for a reason. It certainly is valid to ask if a given rule has outlived its usefulness. It may well be that there has to be an updating of regulations to meet new circumstances, and we should not be afraid to alter or eliminate those that are no longer of use, even as we scrutinize proposed new regulations.

But do we need to eliminate everything? We have to keep in mind that most rules, regulations and programs have as their underlying principle moral and social concerns that never are considered by the marketplace.

There was a time when child labour was a normally accepted practice. Only in the lifetime of our grandparents was it eliminated, and minimum labour standards introduced. Today we think child labour (or 72 hour work weeks at less than minimum wage with no days off) are barbaric. But to this day we rely on it - it's just that we've hidden it under the guise of globalization: many of those bargain consumer products we all search for are that simply because some multi-national trading company is taking advantage of a third world country that doesn't protect its workforce (or ignores written regulations), where labour exploitation of the worst kind is the normal order of the day (and yes, forced child labour still exists today).

If this seems a bit far fetched or unrelated to our industry, do I need to remind you of the tragedy in the Korean shopping centre, where they still don't know how many people were killed when the structure collapsed? There are similar examples, although fortunately not as dramatic even here in Canada.

Let's not throw out the baby with the bathwater in our zeal to reform society. Those who ignore history are doomed to repeat it.


Richard Kadulski
Editor

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design & consulting
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R-2000 design evaluations
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Reading an MSDS

Your client has asked you for a healthy house, and you want to do the right thing. You are about to use a new caulking (or paint, glue, etc) but aren't quite sure how safe it is.

You ask the supplier. He gives you a blank look, then pulls out a material safety data sheet (MSDS) that the manufacturer gave him and gives it to you, telling you all the information you want is there. The supplier doesn't really know what's on the form, so you bravely decide to take a look, just to be safe.

What do you find? A piece of paper that makes an income tax form look like a child's story!

You're not alone! Probably very few people really understand what a MSDS is, or more importantly, how to read one. Even though all larger companies are supposed to have someone responsible for the MSDS, it's probably one or two people in the organization that keep the binders with all the MSDS forms in some form of order. Who actually looks at them is another thing (perhaps it's only the lawyers when something happens, who search for the slightest thread to support an action).

David Rousseau has prepared the following guide to MSDS. Hopefully the next time you are looking for information, or confront one of these sheets, you will be able to understand what it means and what to look for.

Every manufacturer of a product which may have health and safety risks in the workplace is required by law to provide a Material Safety Data Sheet (MSDS) on request. The sheet provides a summary of the chemical composition of a material (though manufacturers are not required to list certain ingredients which are protected trade secrets) including health risks, flammability, handling and storage precautions etc. Manufacturers must disclose the presence of any contents which are listed as carcinogens, potent caustics, explosives, or are high risk for other reasons. Though an MSDS is a technical document requiring some chemistry and health

knowledge to fully understand it, much of it is written in plain language. Collecting MSDS information on paints, varnishes, waxes, glues and cleaners, for example, can provide a basis for comparison, even for the lay reader. Where a more technical analysis is required, someone with WHMIS workplace safety training may be able to assist with interpretation of the data sheets.

Key concepts used in MSDS's are:

TLV *Threshold Limit Value*; the accepted toxicity threshold for a hazardous material. The lower the TLV, the more toxic the agent is.

Typical units: ppm or mg/m³

TWA *Time Weighted Average*; the allowable exposure limit over a working day, usually 8 hrs. The lower the TWA, the more toxic the agent is.

Typical units: ppm or mg/m³

LD50 *Lethal Dose, 50%*; the dose which is lethal to 50% of laboratory animals when ingested. The lower the LD50, the more toxic the agent is when ingested.

Typical units: mg/kg (body weight)

LC50 *Lethal Concentration, 50%*; the concentration in air which is lethal to 50% of laboratory animals when breathed. The lower the LC50, the more toxic the agent is when inhaled.

Typical units: ppm or mg/m³

TVOC *Total Volatile Organic Content*; the volume of the product which will evaporate over time. The higher the TVOC the more the product adds to indoor pollution.

Typical units: % or gms/liter

Health and Toxicity Rating. The estimated health risk from handling, usually on a scale of 0 to 4, with 0 being the safest. There are several different systems for health rating.

Some other useful concepts for interpreting MSDS's.:

Vapor Pressure. The pressure produced by evaporation of the volatile contents of a material. The higher the vapor pressure the more rapidly the volatile contents will evaporate. Typical units: mm.Hg (millimeters of mercury)

Mineral Fiber Content: the presence of potentially respirable mineral fibers which can be released during handling or use. This is especially important for insulations and acoustic tiles.

NFPA Health Risk Number: the National Fire Protection Association has developed a system of classification of risk, primarily for the protection of firefighters. The NFPA method uses three numbers: Flammability, Reactivity and Health. The numbers range from 0 to 4. A product health rated as a 0 can be assumed to be very low in volatile emissions, while a product rated as a 4 is obviously dangerous to handle. This rating is not usually a good indicator of long term performance however, because a product with very volatile contents which is risky to handle (e.g. a solvent lacquer or adhesive) may be very low in emissions once it has cured. However it is a very important rating for renovations of occupied buildings.

Common Abbreviations:

ACGIH	American Conference of Governmental Industrial Hygienists
CAS	Chemical Abstracts Services
N.D.	None Detected
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health
NOEL	No Observable Effect Level
OHSA	Occupational Health and Safety Administration
SARA	Superfund Amendments Reauthorization Act
TSCA	Toxic Substances Control Act
VOC	Volatile Organic Compound
WHMIS	Workplace Hazardous Materials Information System
CCOHS	Canadian Centre for Occupational Health and Safety

The Workers Compensation Board can also provide workplace safety and product information to contractors. They have a library, and their staff can be a valuable resource that isn't accessed often enough.

Window Innovations '95

Window Innovations '95 was an international technical conference on state of the art window technologies held in Toronto, 5-6 June 1995, that attracted participants from 21 countries. It was termed a "fenestration feeding frenzy".

The technical conference on advanced window technologies, a world first, was organized by CANMET, of Natural Resources Canada in cooperation with the International Energy Agency's solar Heating and Cooling Program, Task 18 (Advanced Glazing Materials for Solar and Buildings Applications).

One of the interesting facets of the conference was observing the different concerns of researchers in different climatic zones. For example, an Australian paper examined the use of thermal breaks in aluminum window frames. To a Canadian there is little advanced about thermally broken frames, and such a paper may seem inappropriate for a conference on advanced window technology. However, fenestration needs vary depending on climate and solar radiation. In Australia, because of their warm climate, the use of thermal breaks is an innovation rather than the rule. While we have already determined the need for thermal breaks in Canada, we may be able to learn from the way the Australians are evaluating their own situation.

Also of interest was the source of the delegates. While it was a technical conference with many of the technologies presented still in the research stage, 45% of the attendees were manufacturers! A clear indication of the relevance of research to practical applications and concerns.

The 67 technical papers were presented were a blend of highly technical topics, such as those on chromogenic glazing ("smart" windows that switch properties based on need), and more general interest topics, such as on codes and standards. What became obvious during the conference is the leading role Canada is playing in many areas of window research.

Vision and Frame Computer Software

Most notable of Canada's contributions to window research and development is the widespread use of the Vision and Frame computer programs developed by the University of Waterloo and Enermodal Engineering Limited, respectively, under research contracts from CANMET. One or the other or both of these programs were mentioned as design or analysis tools in about 1 in 5 of the technical papers presented.

The Vision program is used by United Kingdom researchers to evaluate the results of a proposed new device for measuring the thermal, optical and total solar transmission of advanced glazing materials in a single apparatus.

A new window energy rating scheme being developed in

Australia and New Zealand will use a combination of modelling using Vision, Frame and Window, (software from Lawrence Berkely Laboratory) along with guarded hot box tests.

The national Fenestration Rating Council in the U.S. highlights the Frame and the Window Program as important factors in the design and development process by providing cost savings, allowing manufacturers to predict the energy performance of entire product lines.

In Sweden, the Frame program has been made available free of charge by the Swedish government to stimulate the development of advanced window technology.

Insulated Spacers

Insulated spacers are designed to minimize the thermal bridge effect at the edge of the window. Spacers used in advanced windows, along with low-e coatings and gas fill have a considerable influence on the total window U-value due to the thermal bridge effect at the edge of glass. Canada has played a key role in the development of insulated spacers.

Energy Rating (ER) Number

In the 1980s, CANMET initiated a project that supported research and development of testing and simulation methods for window products. The Canadian Standards Association was encouraged to develop an appropriate window thermal performance standard. The results of this activity is an energy rating (ER) number for windows, and subsequently a similar rating for doors. The ER number provides a single number which allows consumers to compare window and door products with respect to energy performance. The ER number will be used in the future National Energy Codes (due to be published in 1996).

The ER concept is unique in the world. In the U.S., the National Fenestration

Rating Council has not yet developed a single number which incorporates both solar heat gain and U-value, while Australia and New Zealand are just in the process of developing a window rating system.

David Olivier and Robert Lowe of England stated: "against background of the need to achieve stabilization of atmospheric CO2 concentrations, it seems appropriate for building designers in temperate climates to aim at a goal of zero space heating energy." Perhaps that is a goal for Canadians to strive to as well, with advanced window products to play a key role in its attainment.

If you want to find out the latest in window technology, proceedings are available for \$70 per copy, bulk purchase discount available. To order a copy, contact:
 Darinka Tolot
 Buildings Group/CANMET
 580 Booth Street
 Ottawa, ON. K1A 0E4



Premature Obituary? EnviroSafe Cabinets is still open for business

In the last issue of SOLPLAN REVIEW we reported that EnviroSafe Cabinets, a Vancouver based cabinet maker that put a priority on environmental responsibility in their products and production processes was shutting its doors. Shortly after we went to press, we were informed that although there were financial troubles, the employees were working on a reorganization plan to maintain the business in operation.

Not unlike many young companies, there are teething problems - getting administration, production, sales and service operating as a smooth well oiled machine. What contributed to the challenge, was that EnviroSafe cabinets set themselves a tremendously ambitious goal in the context of a very competitive marketplace: to produce environmentally responsible "green" products eliminating the use of commonly used toxic solvents and materials. Not only was there the research into raw material product availability and suitability, but also education of the marketplace that such products are feasible and available.

The idea and time must be right, given the interest they have generated. The first installation was the cabinets for the BC Advanced House in 1993. Today they have made sales or have serious expressions of interest not only in BC but Alberta, the USA and Asia. Not all of these are high end custom jobs, many are market oriented developments.

Measuring airflows: the Garbage Bag Test

by Don Fugler

Have you ever had a home owner complain about the performance of some heating or ventilating equipment, wished you had a flow measuring device handy to check out the complaint? Do the phrases "This room is always too cold" or "My bathroom fan doesn't do anything" ring a bell?

The Research Division of Canada Mortgage and Housing Corporation has been testing ventilation system performance for years and even had specialized equipment built for these tests. While this equipment can accurately measure flows, it is bulky, expensive, and fragile to be of real use in day-to-day inspections. So an inexpensive alternative was developed - the calibrated garbage bag!

It's easy to build and easy to use. Open a wire coat hanger up until you have a rough rectangle, and tape the open end of a garbage bag around the wire (the device should look like a big, green butterfly net). Crush the bag up gently to deflate it, hold it over a supply duct, and time how long it takes to inflate it (do not worry about full inflation, just get the bag up and wrinkly) as a bag has a fixed volume, the bigger the airflow, the faster it fills up. CMHC calibrated a standard bag (Glad 66x91 cm) on its expensive machine. (See the graph).

If you do not like graphs, remember these simple numbers:

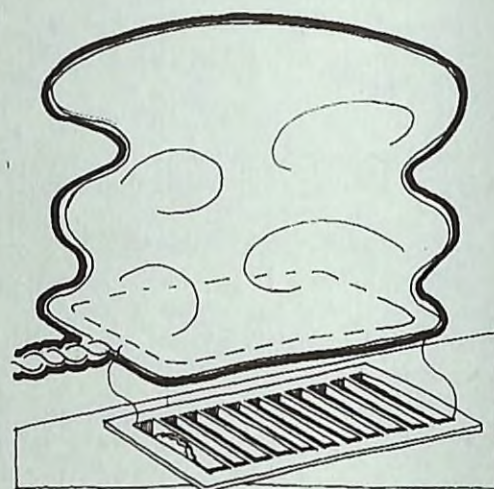
50 cfm = about 3 seconds to inflate,
30 cfm = about 5 seconds,
10 cfm = about 12-13 seconds.

The accuracy is not terrific, but the test certainly will distinguish between a good duct and one that is not working. You can also use the test for exhaust fans by swinging an inflated bag up to a bathroom exhaust grille, and timing how long it

takes to almost completely deflate the bag.

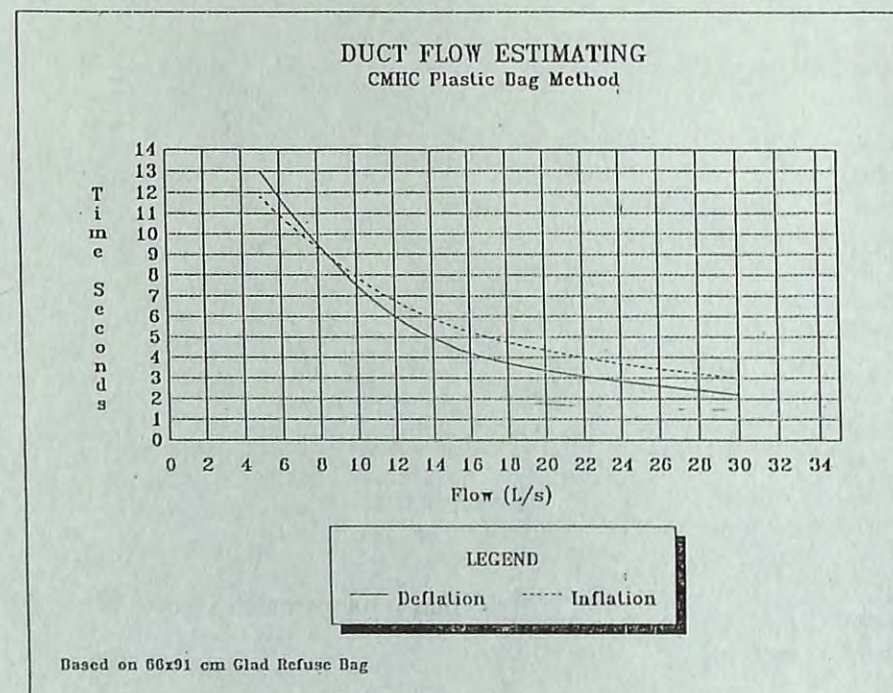
How has this technique been used? A householder grumbled about a cold second floor, despite several visits by his heating contractor. A 15 minute check with the bag showed that only 2 of his 18 supply ducts had flows over 10 cfm (compared to a healthy supply duct flow of 40-80 cfm). Somehow the furnace installer/serviceman had not noticed this critical lack of flow, even after four years of complaints. In another case, a woman phoned about a cold bedroom on the last day of her new home warranty period. She wanted duct work improvements to fix the problem. She was told, over the phone, how to test her duct and discovered she had lots of airflow. Her cold room was due to other factors.

So give it a try. It works well, it works fast, and the results are immediately obvious, to both yourself and the customer.



And, if you don't like the system after trying it out, just put the coat hanger in the bag, top it off with household garbage, and toss the whole works. What do you have to lose?

Don Fugler works for the Research Division of Canada Mortgage and Housing Corporation in Ottawa.



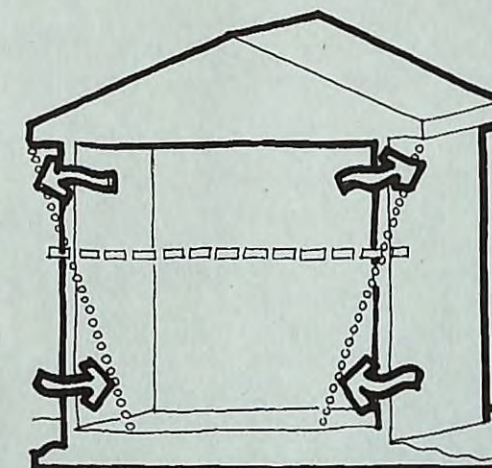
Locating the Neutral Pressure Plane

Stack effect is the action that produces upward flow of warm gas in a chimney. It also produces pressure differences and drafts (air leakage) in buildings. Every house is subject to the stack effect - which means that warm buoyant air flows up, escaping through the openings in the upper portion of the house, replaced by heavier, cold air entering through the lower levels. This is pronounced in winter, when there is a maximum temperature difference between inside and outside (and explains why the upper floor ceiling temperatures are so often so much warmer).

Relative to the outside, the upper portion of a building is going to be at a positive pressure, the lower portion at negative pressure. An extreme example of the stack effect is seen in high rise buildings in the winter (which is why revolving doors are used so often - otherwise you might have difficulty opening a regular door). Fortunately, such extreme pressures are not seen in a house, although the pressure difference can be comparable to wind action on the house.

At a point there is a level at which there is no pressure acting across the envelope. This level is referred to as the neutral pressure level (NPL). The NPL exists when the temperature in a building differs from that outside. With a higher inside temperature the difference in air density produces a negative inside pressure relative to outside at lower levels. The opposite occurs with inside temperatures lower than that outside.

The neutral pressure level is not just an academic concept. Designers can use the NPL to predict the effect on air exchange when a vent, flue or other deliberate opening is added to the building envelope. For example, putting an opening above the neutral plane to provide for a



Neutral Pressure levels	
House configuration	Neutral Pressure level location (% of house height)
No deliberate openings, no flue	55%
No flue, one basement vent open	49%
Flue only	75%
Open flue, plus open basement vent	69%

purely passive intake will not work because of its location relative to the NPL. This also explains why open flues in the lowest level (where there is maximum negative pressure) are subject to backdrafting. Similarly, sewer gases will be sucked inside the house, while any foul smelling odours in the attic (or insulation fibres) will not.

It also explains why opening windows doesn't always provide effective ventilation; why a completely passive ventilation strategy that relies on random air inlet and exhaust will not always work. Most of the air leakage openings are the result of impractical design, imperfect workmanship and limitations of available air sealing techniques.

In an exhaust only ventilation system the neutral pressure plane is artificially moved up, so that the entire house is under negative pressure. Houses with balanced ventilation are not affected by the location of the neutral pressure.

The rule of thumb for the location of the neutral pressure plane of a house has said it was at the mid-height for a house without a flue and two-thirds to three-quarters of the height for a house with a flue. A rule of thumb has been necessary

because the NPL is difficult to measure, as calm conditions are needed to avoid distortions caused by wind.

A recent study at the NRC's Institute for Research in Construction scientifically confirms the neutral pressure rule of thumb, useful for locating air intake vents and flue openings in houses.

The results confirmed that the highest NPL occurs at three-quarters of the above-grade height of the house, while the lowest NPL, at mid-height, occurred when there is no flue but a basement vent open. (Results are summarized in the table).

Masonry Fireplaces

Concerns about energy efficiency and air quality have meant that very stringent requirements have been applied to the use of wood burning appliances in R-2000 houses.

In the case of houses in urban areas this does not necessarily create any problems, as the limited access to wood, and the new found popularity of gas fired fireplaces has meant that very few wood burning appliances are being used today. However, in rural areas gas is not always available and wood still is an appropriate and viable option.

In central and eastern Europe, as well as central Asia, wood burning has been used efficiently for centuries - not the inefficient fireplaces we see as the norm here, but high mass units. These are variously known as Finish or Russian stoves, masonry stoves, or kacheloffen.

These units are always located in the centre of the house, and can tolerate very hot fires, yet they will not overheat the room. The large thermal mass associated with them means that the heat is stored in the masonry and released over a period of time after the fire dies down. The hot fire means there is a complete combustion, and when correctly designed and used, there will be no creosote build-up.

The flue in these types of fireplaces is not just a hole in the ceiling located directly over the firebox, as is standard practice with conventional English or North American fireplaces, but is located to the side of the fireplace - flue gases pass through a series of baffles before going up the flue - that way the maximum amount of heat is retained inside.

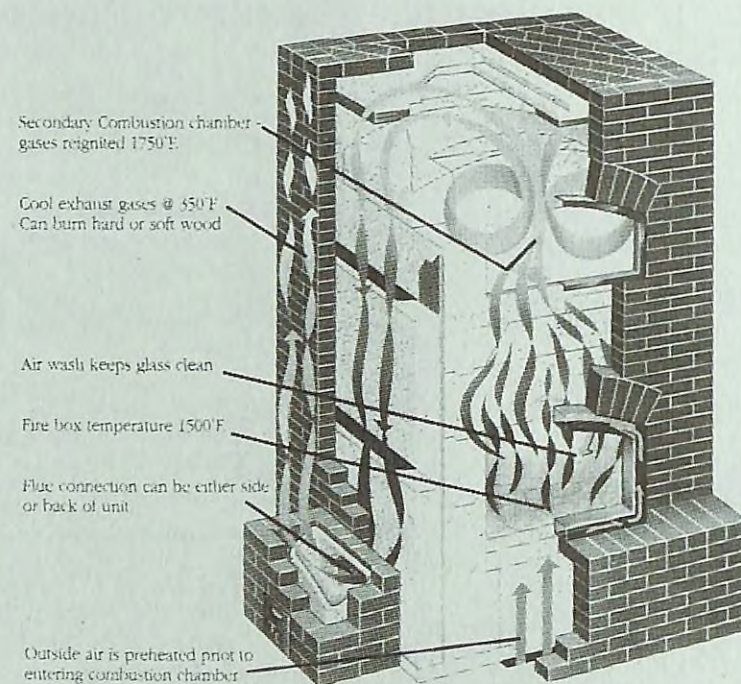
Prefabricated kits are available. Some of the more prominent units now on the market include Tulikivi, a Finish designed, soap stone fireplace that is available in many sizes and designs; refractory core kits that can be finished with any kind of masonry finish that suits the decor

are available from Tempcast and Cross-fire (two Canadian made kits), and Enviroheat from Washington state.

Because these are site built units, up to now they have not been acceptable for R-2000 home use, as the only accepted wood burning appliances were manufactured stoves or fireplaces that met CSA standards or the US EPA wood burning standards. As a result, the Masonry Heater Association, in conjunction with NRCAN, CMHC and CHBA have developed a set of guidelines for masonry heaters that can be used in R-2000 houses.

Units suitable for use in R-2000 houses must meet the following criteria:

- ◆ Outside combustion air must be provided directly to the unit.
- ◆ The unit must have a mass of at least 800 kg (not including chimney or base). Heaters must be designed to allow solid fuel to burn rapidly at high temperature, and capture and store a substantial portion of the heat, which will be released slowly over time to the space to be heated.



◆ The unit must have gasketed firebox doors specifically designed for use in masonry heaters and prevent combustion spillage.

◆ The chimney and masonry heater must not penetrate an outside wall - if located against an outside wall, a vented 4" (100 mm) airspace must be maintained between the heater and the wall.

◆ Basement installation is not recommended.

◆ A carbon monoxide (CO) alarm, either hard wired or battery operated, must be installed in the room where the masonry heater is located.

◆ All units must be installed either by factory qualified installers or qualified masons who've taken an approved course.

Full details are available from your local R-2000 manager.

For more information on the R-2000 Program, contact your local program office, or call 1-800-387-2000 (Fax 613-943-1590)

Multi-unit design evaluation guidelines

The R-2000 program was designed for single family dwellings, but there has always been interest in applying the concept to multi-family projects. The annual energy consumption target, a key part of the compliance criteria is calculated by the HOT-2000 program for single family dwellings. However, because multi-family dwellings have a smaller exposed surface per unit, due to the shared walls and floors between adjacent units, it is necessary to calculate the annual energy consumption target manually.

The release of HOT-2000 version 7 was part of the major changes made to the R-2000 technical requirements last year. The formula that was designed for use with previous versions of HOT-2000 is not appropriate for use with version 7.0, but unfortunately, it was not released with the updated design evaluation guidelines. Anyone working with multi-family R-2000 projects should contact their local R-2000 Program manager for information on the revised Multi-unit energy target formula.

Material Conservation

The R-2000 Technical requirements encourages the use of products with recycled content. One of the "pick-list" items that can be chosen is steel studs with recycled content. The current requirement indicates the recycled content must be 60%.

It appears that this figure was arrived at from information provided about the amount of steel that is recycled - but this is an industry average. In the case of steel stud products, the actual recycled content is in the range of 23-27%. Accordingly, the requirement for 60% recycled content in steel studs has been modified.

HOT-2000 Update (v7.1)

An update to version 7 of HOT-2000 has just been released. Registered users will be receiving their update versions this month. The latest changes are minor modifications that make the software more user friendly. No new models have been added, so the results are unchanged. However, the software is now easier to use. A few of the changes include:

- print-out of building component codes so that you can see what the inputs are (rather than just a cryptic number code);
- a favourites option so that commonly used construction codes can be used, thus avoiding to have to scroll through pop-up menus every time
- an auto move option, so that the cursor moves to the next entry automatically when an input is made
- a new screen for radiant heating systems
- the number of user defined component codes which can be stored has been increased to 32.
- this version has been converted from a 16 bit to 32 bit operation. This means that the program now requires less conventional memory but more extended memory. This also means that the loading time has increased substantially, although once in the program calculation time is the same. On a slower machine, or depending on other software, the slow loading time could be a problem (it was on our 386 running with Stacker compression).

HOT-2000 (v7) Caution

There is one glitch in version 7 that has not yet been corrected. When a gas fired domestic hot water system is called up when using Imperial units, the default energy (efficiency) factor that pops up is not correct (it shows up as 61%, instead of the correct value which is 54-57% depending on heater type). However, if you press "return" on the "tank capacity" entry once, the correct value appears. Apparently this error does not happen when metric inputs are used.

Materials Evaluations

From time to time there is some confusion about how to judge the suitability of new or innovative products for use in R-2000 houses. CCMC product evaluations are used as the basis for determining the acceptability of products.

Products that have been evaluated are published in the **Registry of Product Evaluations**, (updated twice a year) available from:
Client Services, Institute for Research in Construction, National Research Council, Ottawa, ON K1A 0R6

Letter to the Editor

Re: Editor's Comments (Solplan Review, May 1995)

I read with amusement and considerable consternation your editorial about the regulatory authority and the transformer. I think we should have a contest entitled Ridiculous Excess, and I would offer the following:

Natural gas lines cannot be buried in earthquake-prone areas because somebody might be standing near a buried line which ruptures in an earthquake. If that person is a smoker, and if he/she happens to be lighting up when the "big one" hits, he/she will go up in smoke. (Mind you, that scenario has its positive side, too.) (Of course, gas lines could not be surface mounted either, for the same reason plus problems due to vandalism and sabotage).

Another one: (Monsanto will love this idea.) Windows can't be made of anything other than safety glass, as they can break and cut people. (Even without an earthquake.)

I'm sure if your readers put their imaginations to work, they might be able to dream up an excess that surpasses the one you wrote about. But it will be a challenge.

George Pinch, P.Eng.
Vancouver, B.C.

Of course, these are pure flights of fancy. I am sure readers may be able to supply examples of real regulatory excesses. Do any of our readers have others? We await your comments. Ed.



**Canadian
Home Builders'
Association**

Manufactured Wood Floor Systems Testing Program

The use of engineered wood floor joists is increasing; in some areas it has almost become standard practice. However, building regulations haven't completely caught up with this trend so they are often still treated as "equivalencies" under the code, and builders must provide an engineer's letter to satisfy local building authorities for every single project.

A major testing program is being started at the Institute for Research in Construction with the industry. A series of tests will be undertaken to evaluate the fire and acoustic properties of various floor assemblies. The goal is to provide information of how the various systems work.

Up to now, only individual manufacturer's product literature is available, but the intent of the program is to develop generic tables that can be referenced in code documents.

Engineered wood product installation practices

Forintek and the Canadian Wood Council are undertaking a review of allowable deflection limits and installation practices of engineered wood joist systems. There have been some concerns in the past about the amount of deflection in systems, which in extreme cases can lead to cracks in ceiling finishes.

There may be a variety of reasons why problems occur, even when installation was done in accordance with the manufacturer's recommendations. If you have

encountered any problems with the use of engineered wood products, let your local Home Builders' Association Technical Committee know, or contact the TRC directly and provide them with the details. It's only by being able to follow up on any leads that a better understanding of the nature of problems, and how they can be overcome, that problems will be resolved.

There is also a concern about installation practices, especially with rim joist details. Every manufacturer making engineered wood products has comprehensive detail packages, but not all details are always being followed through in the field. In some cases, it may be the result of distributors' marketing practices, as rim joist components are not always sold with the joist packages. It is important to recognize that the rim joists is an integral part of an engineered floor system.

TRC Bulletin Board

We've mentioned that moves are afoot to establish a TRC bulletin board on the Internet. The Ontario New Home Warranty Program has a demonstration home page up and running now.

Envirohome

The Envirohome demonstration initiative is well underway with 7 homes under construction. 3 more applications are being reviewed. Builders are reminded that this demonstration program is an open ended marketing initiative, to showcase environmentally appropriate, energy efficient home building, so that anyone interested should pursue this program. If you need more information, contact John Broniek at CHBA in Ottawa.

Sprinklers

Mention of sprinklers at this time of year brings to mind the lawn and garden variety. However, the residential sprinkler industry along with fire departments are still very active trying to impose mandatory sprinkler requirements in all homes. In BC many municipalities are considering implementing mandatory requirements across the board. The pressure is being kept up by the sprinkler lobby, and they have hired the retired fire chief from Vancouver to be their spokesman.

CMHC has hired independent contractors to assess the actual cost to a municipal government of implementing mandatory sprinkler requirements. This study is due to be completed by December. Up to now, most of the work in the area has dealt with the costs to install sprinklers in an individual building. This infrastructure study will consider such factors as the need to upgrade municipal infrastructure to meet increased water demand,

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector. If you have any problems, technical questions, or suggestions for areas that need to be investigated, you are encouraged to contact your local Home Builders' Association technical committee or the TRC directly at:

Canadian Home Builders' Association, Suite 200, 150 Laurier Ave. West, Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060
Fax: (613) 232-8214

Combustion Vent Clearance

Fuel-burning equipment standards specify minimum clearances around flues to ensure that surrounding materials are maintained at a safe temperature. However, for energy conservation and building durability you want to maintain a tight building envelope. This means there is a tendency, reinforced by new building codes to reduce these clearances and increase the airtightness of flue penetrations. What does this do to temperature of adjoining combustible materials?

Research by Scanada Consultants Limited and Underwriters' Laboratories of Canada for CMHC looked at the effect of varying the clearances and sealing the flue penetration into the attic, on the temperature of combustible materials in the joists.

In addition, exterior B vent chase temperatures were measured when levels of insulation, furnace cycling times, and air infiltration rates were altered.

Type A flues are used for venting the combustion gases from wood burning appliances while Type B Vents are used for venting the combustion gases from gas burning appliances.

Exterior gas vents are often enclosed to avoid condensation of flue gases, reduce possible backdrafting, provide protection from physical damage, and to provide a wind break, but there is no data to support an argument that exterior B vent chases should be insulated. Insulation alone may not be effective because of the high air infiltration rates in most chases.

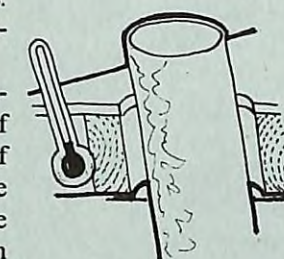
The average equivalent leakage area of a small sample of existing B-vent chases tested was 341 cm², which translates to a normalized equivalent leakage area of 12 to 35 cm²/m² - large compared to the average house. Typical NLA values for

houses range from 0.44 to 6.77 cm²/m² (the R-2000 limit is 0.70 cm²/m²). Normalizing the equivalent leakage areas provides a means of comparing the results with typical values for other structures such as houses.

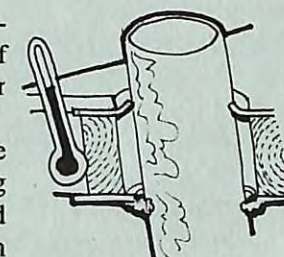
This means that the natural winter air infiltration rate (ignoring the effect of

Attic Clearances

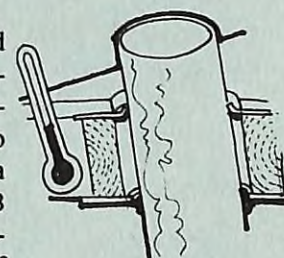
There are a number of ways to seal the flue penetration through the ceiling. Seven different configurations were tested.



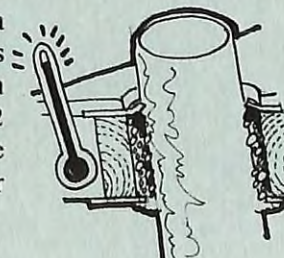
1. A firestop was placed on the underside of the clearance space and not sealed.



2. A second firestop was installed on the top side of the clearance space and sealed to the chimney.



3. The two firestops were sealed to the chimney.



4. Insulation was placed in the joist spaces. Both the top and bottom firestops were sealed.

wind) is a more important heat loss component than the insulation level of the enclosure. The ambient air temperature in the chase, and the flue surface temperature, are influenced more by the infiltration rate, the furnace cycling time, and the initial air and enclosure temperatures than the insulation level of the enclosure.

5. The clearance space was increased to 100 mm. The top and the bottom firestops were sealed to the chimney.

6. The clearance space was increased to 150 mm. The top and the bottom firestops were sealed to the chimney.

7. The clearance space was reduced to 0 mm. The top and the bottom firestops were sealed to the chimney.

It was found that the temperatures in the joist box increase as the clearance space is reduced and the top and bottom plates are sealed. Surprisingly, it was noted that insulation in the space increases the temperature of the outer surface of the chimney while the surface temperature of the joists surrounding the chimney are not significantly reduced. In four of the seven tests conducted, the temperatures of the combustible material in the joist space exceeded the maximum temperature rise of 65°C permitted by standards. However, only one configuration (no clearance) had a substantially high temperature (122°C). The others were within 10°C of the maximum allowed.

Increasing the clearance between the outer surface of the chimney and the joist lowered the average temperature in the joist box when the joist box was sealed on the top and on the bottom firestops.

Continued on page 12

Doors as Sound Barriers

Doors in multiple-unit buildings provide security and offer some fire resistance. Access doors are also sound barriers, although their effectiveness varies.

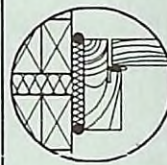
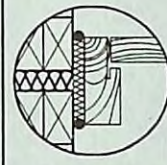
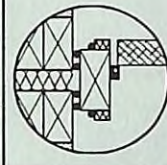
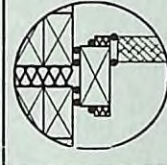
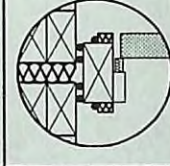
But how effective a sound barrier are they?

A study that looked at the sound proofing qualities of access doors installed in low-or medium-cost multiple-unit buildings was done by acoustical consultants in Montreal for CMHC.

Five different door assemblies were examined. The soundproofing of the door itself was compared to the soundproofing provided by the perimeter gasketing. This was done by testing the doors as normal (operable) doors and as if they were sealed to their frame.

Solid core wood door (1 3/4") The most economical doors that meet the building code is a 4.5 cm (1 3/4") thick solid door with a particleboard core and high-density masonite laminated surfaces. These doors usually come pre-hung in frames equipped with gaskets and bottom seals. This was one of the least effective at blocking noise. Adjusting or replacing the perimeter and bottom gaskets would improve its performance but only marginally.

Thick solid core wood (2 1/4") door Some believe that a thicker door will improve sound isolation. Testing showed that this is not the case. When sealed to the frame, the thick solid core wood door provided only slightly better performance than the thinner 4.5 cm (1 3/4") door. When both doors were operable, their STC rating was identical.

Description	STC value		Price	Cross Section of Operable door
	Operable door	Sealed door		
4.5 cm (1 3/4") wood door	28	31	\$142.75	
5.7 cm (2 1/4") wood door	28	33	\$214.75	
4.5 cm (1 3/4") filled metal door	27	37	\$319.80	
4.5 cm (1 3/4") hollow core metal door	—	36	\$309.80	
4.5 cm (1 3/4") sound- and fire-rated door with silicate core	32	37	\$625.00	

What is STC (Sound Transmission Class)?

The **STC** is a single number used to rate the sound insulation properties of a building assembly. The larger the STC number, the better the noise isolation.

Sound transmission through building assemblies depends on many factors, not just the materials but also the nature of the sound, as different frequencies behave differently depending on loudness. Because the human ear can hear a range of frequencies, transmission loss measurements are taken at several points in the 125 to 4,000 Hz band. The STC is derived by comparing known transmission loss curves for various frequencies and loudness readings.

Transmission losses are not just affected by the construction of the assembly itself, but also by the flanking paths such as holes, unsealed joints, penetrations, etc. where airborne noise can travel. That is why air tight building envelopes help make the interior much quieter by reducing the pathways through which airborne noise that can travel into the building.

Sound transmission loss must not be confused with **sound absorption**. Sound absorbing materials control sound within a room, reducing echoes and reverberation, but will allow sound to pass through them quite easily. They do not insulate against sound. Materials that are good sound insulators, reducing transmission loss are heavier, and generally will reflect the sound back into the room.

Insulated metal door, 4.5 cm (1 3/4"):

The STC rating and transmission loss results for the insulated metal door were comparable to those of the wood doors. When the metal door was sealed to its frame, it produced significantly better results, suggesting that improving the gasketing would improve performance.

Insulated vs. hollow core metal doors.

A 4.5 cm (1 3/4") metal door with mineral fibre insulation in the cavity performs slightly better than a hollow core metal door.

Continued from page 11

Combustion Vent Clearances prepared for:

Canada Mortgage and Housing Corporation, Ottawa, ON K1A 0P7
by: Scanada Consultants Limited with the Underwriters' Laboratories of Canada Inc

The Healthy Household

A Complete Guide for Creating a Healthy Indoor Environment

by Lynn Marie Bower

The increased use of man-made building materials, as well as synthetic cleaning products, personal-care items, and furnishings, coupled with tighter home construction, has resulted in interior environments capable of causing illnesses ranging from headache, depression, asthma, and Multiple Chemical sensitivity to cancer and even death.

Using low-odour, less-toxic products and materials can be a major factor in making homes, and the people who live in them, healthier.

This is an excellent guide for anyone who is concerned about maintaining a clean indoor environment. It has been written by Lynn Marie Bower who herself has been ill for 15 years with Multiple Chemical Sensitivity. (MCS) - an environmental hypersensitivity condition in which individuals react negatively to minute exposures of various synthetic chemicals. Lynn acquired MCS as a result of using typical products and materials during an extensive home remodelling/restoration project. She learned the hard way how potentially harmful many of the popular products sold in stores can be.

The Healthy Household contains hundreds of specific suggestions for products and techniques to transform any home environment from a place that compromises health to one that can actually enhance it. Included are sources of healthier toiletries, clothing, bedding, and furniture, as well as floor, wall, and window treatments. Also covered are healthier cookware, household storage, and less-toxic pest control.

There are suggestions for virtually every household cleaning job, and a comprehensive coverage of paints, stains, and other home-workshop materials.

Available: for US\$ 17.95 from
The Healthy House Institute
430 North Sewell Rd
Bloomington, IN 47408

E-House Indoor Air Quality Product Guide™

This is a directory of manufacturers and trade organisations in the indoor air quality industry. Over 500 entries are included, featuring thousands of products ranging from paints, flooring, and insulation to heat recovery ventilators, air filters, and water purifiers. The database offers contact information, trade names and product descriptions. It's offered in a hard copy as well as on computer disk in either Macintosh or Windows format. The software version has an easy-to-use graphic interface and allows searches for building products by company name, CSI number, product description, trade name, keyword, or location.

Available for us \$ 50.00 direct from

E-House™ Environmental Building Consultants
312 A Jefferson Ave.
Cheltenham, PA 19012-2121
Tel/Fax: (215) 663-1611

Sound- and fire-rated 4.5 cm (1 3/4") door for which the manufacturer certifies an STC rating. The door tested had a rating of STC 36, but it actually only achieved an STC of 32. When tested sealed, its rating of 37 was similar to that of the insulated metal door. This indicates that the double perimeter gaskets and bottom seal installed on the sound-rated door significantly improved its performance.

Tests of perimeter and bottom gasketing showed that the gaskets can improve the sound isolation performance of a door assembly. Where the difference in sound performance between sealed and operable tests for the same door is more than 5 STC points, the performance of the operable door could be improved by doubling the gaskets at the perimeter and bottom of the door. With double perimeter and bottom seals, almost all of the doors tested could achieve STC ratings of 30 or better.

A recent trend in multi family buildings is to pressurize corridors. This confines odours inside dwellings, supplies fresh air and compensates for the air exhausted by bathroom and kitchen fans and clothes dryers. However, leaving a gap at the bottom of the door to allow air in from the corridor to the dwelling eliminates the sound-proofing. It is more effective to leave an opening above the door and treat it with a piece of lined duct or a silencer that will maintain the noise isolation provided by the door.

Research project on the noise isolation provided by access doors in multi-dwelling buildings

by MJM Acoustical Consultants Inc.,
Montreal, Quebec.

The Great Canadian Reno-Demo Project

Over the past year we've been running progress reports on your editor's renovation project of an 80 year old house in North Vancouver.

The intent has been to demonstrate the potential of recycling housing stock, incorporating environmentally responsible energy efficiency (space heating energy consumption is reduced by 60%) and healthy home renovation approaches suitable for new and retrofit construction.

An unfinished grade level basement was developed into a one bedroom suite, taking advantage of the site and solar orientation, maintaining existing trees. A secondary suite also demonstrates a way to maintain neighbourhood character while densifying the city, without resorting to demolition.

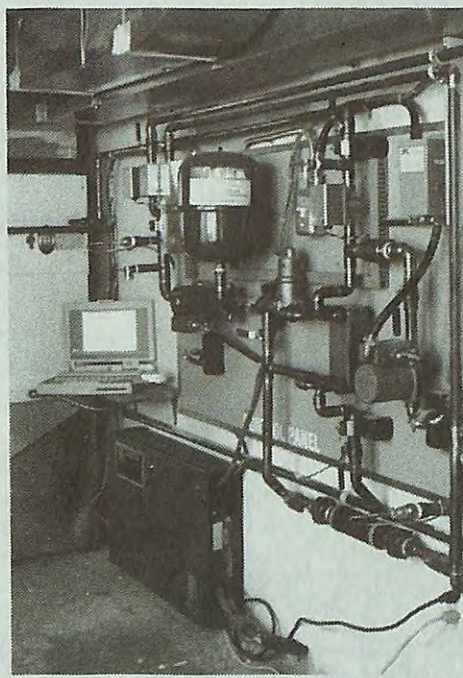
Now that the construction is virtually completed (or as much as it is likely to be for some time) we thought it would be appropriate to let readers see some pictures to prove it was a real project.



South side before



South side after. Overhang provides summer shading for south windows. Solar collector preheats city water entering hot water circuit.



Portion of integrated mechanical system.

A compact Delta-Temp direct vent gas heater heats water (preheated by the solar collector). Water is stored in a standard insulated water tank. Forced warm air heating for upper floors uses an Energy Saving Products fan coil which takes heat off the hot water storage tank as required. The floor radiant heating system in the new basement level takes heat off the hot water tank, through a heat exchanger (so as not to circulate potable water through

the floor). To save on-site installation time, pumps, controls and headers are preassembled on a Hydrowest Products control panel (shown on the photo).

Ventilation air is supplied through an Eneready vanEE 1000 heat recovery ventilator; on the upper floors the fresh air is supplied through the heating system, downstairs it is distributed directly to each room. Exhaust in all baths is controlled by PoshTime whisper Power Gills, to provide optimum zoning of exhaust air.

This mechanical strategy was selected for the inherent efficiency of integrated heating systems, plus the need to provide a total separation of controls and air movement between the two dwelling units.

The computer is part of the monitoring program. Temperature sensors have been installed in the floor slab and below the insulation, as well as outside the house in the ground at several points. There are two heating zones in the suite, one has R12 rigid insulation under the floor, the other has R20. The performance of the slab will be monitored for the next two years by BC Hydro and NRCAN. Results should help to provide an understanding of heated floor slab performance.



Interior view of living area. Ceramic tiles were used for floor throughout to provide low emissions finish. Space heating is in-floor radiant heating.

Fireplace Doors and Smoke Spillage

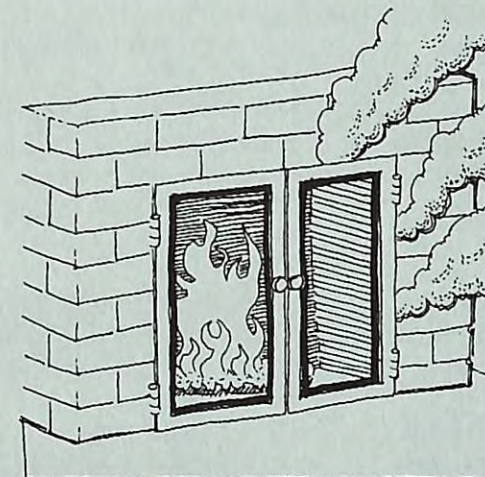
As homes become more energy efficient the amount of house depressurization has become a concern. For a given quantity of exhaust air a draft free home will experience more depressurization than a very leaky, drafty house.

The concern with depressurization is that there is more likelihood that harmful combustion gases will be drawn back into the house through the flue. Today's energy efficient furnaces with sealed combustion have less of a problem, although most gas domestic water heaters are still naturally aspirating (relying on natural drafts in the flue). However, wood burning appliances, especially fireplaces, are a concern. Many codes even call for "tight fitting" doors, the intent being to reduce pressure induced spillage. Unfortunately, there is no standard for how tight "tight" is. The assumption is that the addition of glass doors to masonry fireplaces will reduce this spillage.

CMHC commissioned a study of fireplace spillage and fire safety tests on a masonry fireplace. The spillage tests were designed to examine the impact of glass doors on smoke and gas spillage; carbon monoxide (CO) concentrations were used to provide the spillage indicator. Tests were run with depressurization limited to 10 Pa. It is important to remember that much higher depressurization levels even in drafty houses (especially on the lower level of a two storey house) are possible.

The design of the door itself is important. Ceramic glass doors (which are expensive) can be made very airtight especially if gasketed. Tempered glass doors are cheaper, and more commonly used, but because of the need to allow for thermal expansion and to cool the glass, these doors are usually quite loose to allow for a film of air to wash past the glass. Does leakage compromise the spillage protection of the doors?

For the test, door leakage was varied by adjusting the gap between the door frame



and the fireplace. When the fireplace doors were closed spillage tests showed a sizable reduction in CO spillage compared to tests with open doors. However, the CO spillage was not consistent with the amount of door leakage. The CO spillage sometimes increased and sometimes decreased as the external air supply opening was adjusted from closed to intermediate to open.

Similarly, there was little correlation between the size of the outside air supply opening and the amount of spillage.

What happens to the door temperature when the glass doors are closed after a reload? Glass door temperatures can increase at rates up to 20°C/minute. Although this thermal shock did not damage the ceramic glass doors tested in this study, it could be a problem with low quality doors. The highest glass door temperatures were noted when the leaks were localized at the sides of the door frame, while the lowest were when all the

leakage was at the bottom of the door.

What about the temperature of the fire itself - will a glass door lead to higher temperatures in the fire (a potential safety hazard to other combustibles)? This was not considered, although the effect of doors on the fireplace was, especially if the closed doors will contribute to hotter fires, which could lead to higher glass door temperatures. No significant temperature changes were noted.

Other factors which could affect temperatures and/or spillage were not varied in this study: chimney height, length of fire, fuel, fuelling, etc. The effects of glass doors on creosote formation and the potential for chimney fires were not considered in this study.

What does the study tell us?

The addition of glass doors dramatically but not totally reduces fireplace spillage. How well the doors are sealed and the presence of an outdoor air supply also influence the spillage, but to a lesser extent. There not appear to be a consistent pattern in door spillage leakage.

*The Effects of Glass Doors on Masonry Fireplace Spillage and Surface Temperatures prepared by: David J Honeycutt, Dennis R Jaasma, and Curtis H Stern
Department of Mechanical Engineering, Virginia Polytechnic Institute and State University
for Canada Mortgage and Housing Corporation*

Restructuring at NRCAN

Natural Resources Canada has announced a corporate reorganization effective August 16, 1995. This is a fallout of the program review that was announced in the last federal budget.

Of interest to the building industry is that CANMET, the research and

development branch of the ministry which has been a separate entity is now becoming the new Energy sector of the ministry, which will be responsible for CANMET's energy laboratories, related science activity and energy policy and programs, as well as the Buildings group.

The Heat Recovery Shower (HRS) Demonstration Project

You are invited to participate in the independent testing of an exciting new product: the heat recovery shower (HRS). You will be involved in one of the most advanced field tests ever done on an appliance.

Why a heat recovery shower? When your family uses the HRS you are going to notice a dramatic reduction in your energy bill - especially if you have teenagers who love their showers. The more showers are that are taken, the more you use the HRS the higher your savings. You can estimate your potential monthly savings when you enter your family's showering habits into the Data Sheet (see facing page) to estimate your monthly savings.

For increased comfort and control, a microprocessor is used to set water temperature and flow. The power of the microprocessor and user friendly controls makes it easy and safe for all ages to use the shower - an LCD bar graph display is used for temperature control.

As the power of computers has grown, computing costs have now reached a point where detailed field testing can be done economically. With this special offer, when the HRS is installed your savings will be precisely measured and recorded by the computer, as part of the monitoring program.

This is a one time, Special Price for these HRS packages. This Special Price is partly due to your purchasing factory-direct as well as the participation of CMHC and NRCAN. Not only will you get the HRS at an unbelievable price but you get to keep the complete test package too!

You can order the HRS test package with either the:

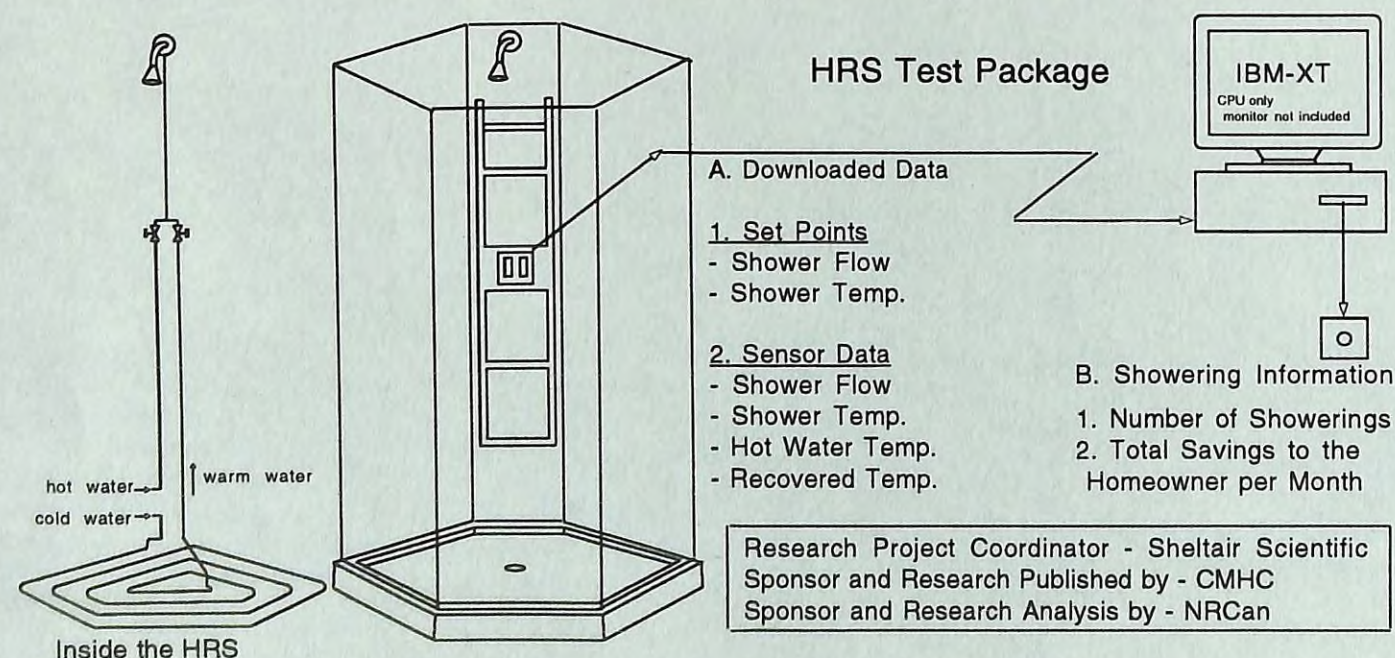
Model -38W mpc Neo angle HRS-RG (regular glass set) Special Price = \$750 (regular = \$1,765)

or

Model -38W mpc Neo Angle HRS-FG (frameless glass set) Special Price = \$1030 (regular = \$2,165)

We only have 25 HRS test packages at this price so put in your order soon! (United States residents are welcome to participate too). To reserve your order or for more information, give us a call.

Heat Exchangers NF Inc. 26 Georgia Dr. Stephenville, NF. A2N 2T5 Tel: (709) 643 6046



Data Sheet for calculating Total Energy Consumption for Showering

Family Members (example calculation)	Showering time (minutes)	waterflow =10 liters/min.	Shower temperature warm (35-5 C) = 30 C warmer (40-5 C) = 35 C hot (45-5 C) = 40 C	Shower Frequency showers/week	Weekly Total liters-C
a (Gerald)	(5)	X 10	X (40 hot)	X (6)	= (12000)
b (Carol)	(10)	X 10	X (35 warmer)	X (8)	= (28000)
c (Lisa)	(20)	X 10	X (30 warm)	X (14)	= (84000)
d (James)	(10)	X 10	X (35 warmer)	X (7)	= (24500)
e		X 10	X	X	=
f		X 10	X	X	=
g		X 10	X	X	=
h	Total weekly consumption (liters-C) = total of rows a to g				= (148500)
i	For a non HRS shower, the weekly cost of energy = Total weekly consumption in liters-C X (\$.0000812)/liters-C				= (\$12.06)
j	For a non HRS shower, monthly cost of energy = Weekly cost of energy X 4.2				= (\$51.74)
k	Average HRS efficiency = 70%. HRS consumption = .30 X For a non HRS shower				= (\$15.52)
l	Total savings per month using a HRS (subtract line k from line j)				= (\$36.22)

Formulas

1. It takes .00116 KWH (kilowatt hours) to raise the temperature of 1 liter of water 1 degree Centigrade (liters-C)

2. In your area, the cost of electrical energy is (\$.07) per KWH. Therefore 1 liters-C = .00116 KWH X (\$.07) per KWH = (\$.0000812) (enter in line i above)

3. It has been assumed that the yearly average cold water temperature is 5 degrees Centigrade. When this cold water is heated to shower temperature, the energy required is the difference between the cold water temp. and the shower temp. For example: for a hot shower of (45 C) the water temp. must be raised 45 C- 5C = 40 C. Therefore 40 should be put into the shower temp. column in the data sheet above if you take hot showers.

4. 10 liters/ min. = 2.64 U S gallons/min. This would be considered a low flow shower head.

Heat Exchangers NF Inc. 26 Georgia Dr. Stephenville, NF. Ph. 709 643 6046

GreyWater Heat Recovery

Grey water heat recovery is something that has always been discussed when energy efficiency strategies are considered. A lot of energy is used to heat domestic hot water for bathing, washing, and laundry. Dumping used hot water costs money, wastes energy, and contributes to pollution. It is estimated that an average family uses about 22 million Btu (7,000 kilowatt hours of energy) per year just to stay in hot water.

The principle of grey water heat recovery is simple: water that is being discharged goes through a heat exchanger to so that it can preheat incoming cold water, be it well or city water. The challenge is to create an effective, economical heat exchanger that will not be fouled by any solid build up (and waste water contains a lot of material that potentially could foul the piping, which is how Roto Rooter stays in business), and to avoid the potential contamination of the incoming fresh water by the waste water when a leak develops.

Now there are two approaches to grey water heat recovery that are being put on the market. One is a whole house grey water heat recovery system, called the DrainGain, the other is the Heat Recovery Shower (see page 16-17). The heat recovery shower deals strictly with water in the shower circuit. Depending on the size and age of the family, the shower alone can account for a major portion of water used.

The DrainGain is a whole house grey water heat recovery system. The potable (incoming) water is separated from the waste water by a double walled heat exchanger. The waste water tank is not pressurized, so that should a leak develop in the potable water line. Two separate coiled heat exchangers are submerged in clean water inside a plastic tank. Waste water flowing through the coil heats the incoming cold water flowing through the second sealed coil. An independent test

has shown heat recovery rates of 40%.

Part of the system includes a non blocking, in line separator which directs solids to the sewer, not to the heat exchanger tank. The device has no moving parts. They can be as small as 30 litres for a dishwasher, 200 litres for a house, up to several thousand litres for commercial or institutional use. Any temperature grey water can pass through the DrainGain with no stored-heat loss. It uses no power, and can be installed in new or old buildings and requires virtually no maintenance.

A prototype unit was installed in a 32 resident nursing home in July 1994, and has operated trouble-free since then. The owner estimates that the unit has already recovered its cost.

The anticipated cost of the DrainGain will be around \$500 for a single family house.

At the moment, the developer is manufacturing arrangements are still being negotiated.

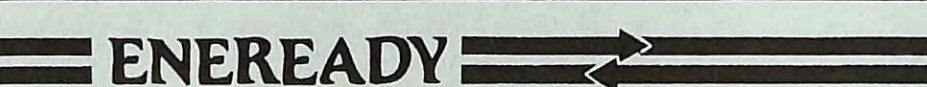
For information:

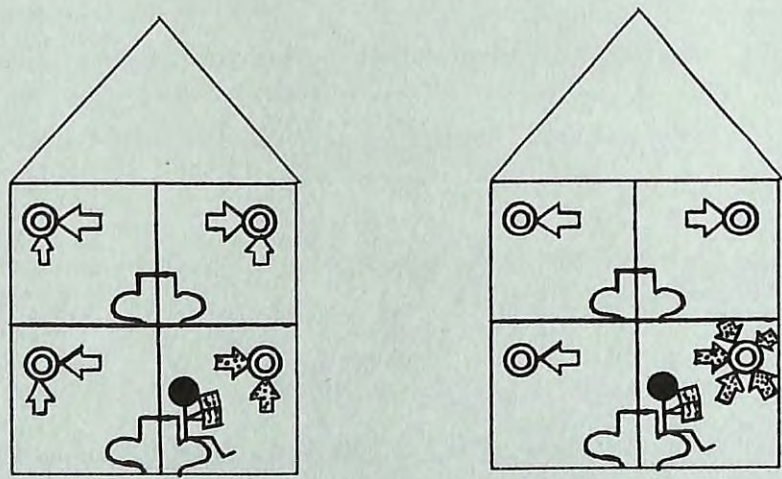
DrainGain:

Winston MacKelvie, Inventor
Box 1156, Knowlton, PQ J0E 1V0
Tel: 514-243-6850
Fax: 514-243-5531

Heat Recovery Shower:

Heat Exchangers NF Inc
26 Georgia Dr. Stephenville, NF. A2N 2T5
Tel: (709) 643 6046





WHICH VENTILATION CONTROL STRATEGY
IS MORE EFFICIENT?

Coming Events

September 1995

Electric Heating System Seminars

Seminars on "Energy Efficient Electric Heating" will cover proposed energy code regulations, heat loss calculations, The Power Smart new Home Program, high performance heating controls, new heating products on the market, and how to install heating equipment for improved comfort and energy efficiency.

Sept. 5, 1995 - Campbell River

Sept. 6 - Courtenay

Sept. 7 - Duncan

Oct. 17 - Kelowna

Oct. 19 - Kamloops

Nov. 21 - Port Alberni

Nov. 22 - Nanaimo

Nov. 23 - Victoria

Nov. 28 & 29 - Lower Mainland

For information:

BC Electrical Association (604) 279-9017

Sept 27-29, 1995

International Lighting Exposition

Metro Toronto Convention Centre

Toronto, ON

Information: Tel: 905-890-1846

October 15-16, 1995

CIPEX'95 West,

Vancouver Trade & Convention Centre

Vancouver, BC

Plumbing and heating industry trade show

Information: Tel: 416-695-0447

October 31-Nov 2, 1995

Energy & Environment Conference, Toronto, Ont.

21st Annual Conference of the Solar Energy Society of Canada

250-2415 Holly Lane

Ottawa, On K1V 7P2

Fax 613-736-8938

October 30-31, 1995

Home & Building Automation '95

Radisson Hotel des Gouverneurs, Montreal, PQ

Information: Tel: 613-990-7407

December 4 - 8, 1995

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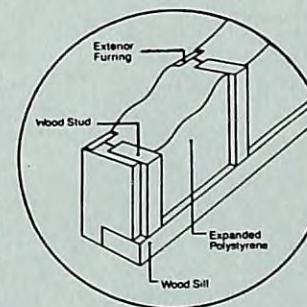
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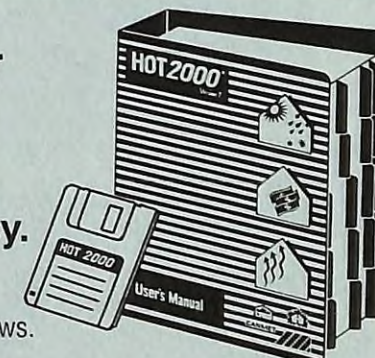
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